

METHOD AND CIRCUIT FOR PROVIDING A HORIZONTAL SCAN SIGNAL FOR A TELEVISION SET

5

Field of the Invention

The present invention relates to a method and a circuit for providing a horizontal scan or line scan control signal of a TV set.

10 **Discussion of the Related Art**

Fig. 1 schematically shows the general architecture of a circuit for providing signals for controlling the vertical and horizontal scanning of a TV set.

Figs. 2 and 3 show signals characteristic of the circuit of Fig. 1.

Generally, and neglecting carrier frequencies, a TV set receives a composite video signal CVBS which comprises a frame signal 4 comprised of video signals 5, each corresponding to the information to be displayed on a line of the TV screen, separated by horizontal synchronization (or line synchronization) pulses 6. Between two frame signals 4, composite video signal CVBS comprises an area only containing synchronization signals which divide into so-called frame pre-synchronization signals 7, so-called frame synchronization signals 8, so-called frame post-synchronization signals 9, and so-called horizontal synchronization setting signals 10.

Composite video signal CVBS is provided to a separation unit 11 (SYNC. SEPARATOR) which provides a horizontal and vertical synchronization signal Svhs. Unless otherwise mentioned, the signals considered hereafter will be substantially binary signals having a high state and a reference state, respectively designated as 1 and 0 hereafter. Some specific binary signals may vary between a low state, designated as -1, and the high state. Signal Svhs substantially corresponds to inverted composite video signal CVBS without video signals 5. Signal Svhs ensures the vertical and horizontal synchronization of the TV screen scanning. Signal Svhs is transmitted to a vertical synchronization separation unit 12 (VERTICAL SEPARATOR) which provides a vertical synchronization signal Svs equal to 1 over the entire duration of frame synchronization signals 8 of the CVBS signal and equal to 0 otherwise. Signal Svs is transmitted to a signal provision unit 14 (VERTICAL SIGNALS UNIT) adapted to

generating, from S_{VS} , a vertical screen scan control signal and a horizontal synchronization inhibition signal S_{FRI} transmitted to the input of an inverter 16 having its output connected to an input of a logic AND gate 18. Signal S_{FRI} is at 1 over the entire duration of frame synchronization signals 8 and of frame post-synchronization signals 9,
5 and at 0 otherwise. The other input of logic gate 18 receives synchronization signal S_{VHS} . Logic gate 18 provides a horizontal synchronization signal S_{HS} transmitted to a phase-locked loop 20 and equal to 0 when S_{FRI} is at 0 and equal to signal S_{VHS} otherwise. Signal S_{FRI} is used to deactivate loop 20 during the return of the vertical screen scanning before the beginning of the display of a new frame.

10 Phase-locked loop 20 comprises a phase comparator 22 receiving as an input horizontal synchronization signal S_{HS} and a signal PH with a 1/2 duty cycle. Phase comparator 22 compares signals S_{HS} and PH and provides a loop current I_{PLL} to a capacitor 24. Voltage S_C across capacitor 24 is applied to the input of a voltage-controlled oscillator 26 (VCO). Voltage-controlled oscillator 26 generates a periodic
15 oscillation signal S_O with a 1/2 duty cycle equal to 1 or -1, the frequency of which depends on control signal S_C . Signal S_O is provided to a frequency divider 28 (/) and to a signal provision unit 30 (HORIZONTAL SIGNALS UNIT). Frequency divider 28 provides signal PH which is equal in frequency to signal S_{HS} when phase-locked loop 20 is locked. Signal generator 30 especially generates signals S_{HS} for controlling the
20 horizontal screen scanning.

In Fig. 3, horizontal synchronization signal S_{HS} is represented at an enlarged scale with respect to Fig. 2. The phase comparator compares signals PH and S_{HS} to provide current I_{PLL} equal to a value $+I$ when signals PH and S_{HS} are both at 1, to a value $-I$ when signal S_{HS} is at 1 and signal PH is at -1, and equal to 0 when signal S_{HS} is at 0. In normal
25 operation, the frequencies of signals S_{HS} and PH are identical and the falling edges of PH occur in the middle of the synchronization pulses of S_{HS} . Current I_{PLL} successively switches from 0 to $+I$ when signal PH is at 1 and signal S_{HS} switches from 0 to 1, to $-I$ when signal S_{HS} is at 1 and signal PH switches to -1, then again to 0 when signal S_{HS} switches to 0. When current I_{PLL} is at $+I$ or at $-I$, voltage S_C across capacitor 24
30 respectively corresponds to an ascending ramp 32 or a descending ramp 34. When current I_{PLL} switches from $-I$ to 0, voltage S_C keeps the value acquired at the end of descending ramp 34.

In normal operation, ascending ramp 32 and descending ramp 34 of control signal S_C are symmetrical. Control signal S_C then keeps a substantially constant value before and after a pulse of horizontal synchronization signal S_{HS} . The frequency of oscillating signal S_O thus is substantially constant. When the frequency or the phase of signal S_{HS} varies, ramps 32, 34 are no longer symmetrical so that the average value of signal S_C varies to adapt the frequency and the phase of signal PH.

Currently, to prevent the copying of the composite video signal, for example, on a video tape, parasitic pulses are added between two pulses of the horizontal synchronization signal on a portion of composite video signal CVBS. Generally, parasitic pulses are only added at the level of the signal for setting the horizontal synchronization 10, that is, for example, from the fifth to the twenty-first line, before the beginning of a frame signal.

Fig. 4 shows an example of a possible shape of horizontal synchronization signal S_{HS} comprising horizontal synchronization pulses 39 and parasitic pulses 40. The number, the position, and the width of parasitic pulses 40 between two synchronization pulses 39 may be variable.

Parasitic pulses 40 tend to disturb the operation of phase-locked loop 20 by varying the frequency of oscillating signal S_O from which the signals controlling horizontal screen scanning signals S_{LS} are generated.

When parasitic pulses 40 are no longer present, phase-locked loop 20 tends to recover the frequency and the phase of horizontal synchronization pulses 39. However, due to the time constant of loop 20, the recovery may extend over several lines. The first video signals 5 displayed on the screen may then be offset with respect to the vertical left-hand edge of the screen.

To solve such a disadvantage, there is a tendency to temporarily increasing the time constant of the phase locked-loop as long as parasitic pulses 40 are present, to limit the frequency variations of signal S_O , then to return to a normal time constant when parasitic pulses 40 are no longer present. However, in this case also, the phase-locked loop may not recover sufficiently fast the frequency and phase of horizontal synchronization pulses 39. The first lines displayed on screen may then be shifted with respect to the vertical left-hand edge of the screen.

Summary of the invention

The present invention aims at a method and a circuit for providing a horizontal scanning synchronization signal for a TV set, which are little sensitive to parasitic pulses.

To achieve this object, the present invention provides a method for providing a horizontal scan control signal for a TV set from a horizontal synchronization signal contained in a composite video signal, the horizontal synchronization signal containing horizontal synchronization pulses and parasitic pulses, said scan control signal being provided from an oscillating signal generated by an oscillator of a phase-locked loop receiving the horizontal synchronization signal, said oscillating signal having a frequency depending on a driving signal provided from the comparison of the horizontal synchronization signal and of a binary phase signal, in which, at each parasitic pulse among successive parasitic pulses between two synchronization pulses, the driving signal is successively varied in the increasing direction or in the decreasing direction.

According to an embodiment of the present invention, the parasitic pulses have variable durations.

The present invention also provides a circuit for providing a horizontal scan control signal for a TV set from a horizontal synchronization signal contained in a composite video signal, the horizontal synchronization signal containing horizontal synchronization pulses and parasitic pulses, said circuit comprising a phase-locked loop receiving the horizontal synchronization signal comprising an oscillator generating an oscillating signal from which is provided the scan control signal, the frequency of the oscillating circuit depending on a driving signal provided from the horizontal synchronization signal, and further comprising a means for correcting the driving signal which, at each parasitic pulse among successive parasitic pulses between two synchronization pulses, alternately varies the driving signal in the increasing or decreasing direction.

According to an embodiment of the present invention, the circuit further comprises a comparator for comparing the horizontal synchronization signal and a modified phase signal and providing, according to the comparison, a current of zero amplitude or of constant amplitude and of variable sign; a capacitor run through by the current and providing the driving signal; and a correction circuit providing the comparator with the modified phase signal corresponding to a binary phase signal having

a frequency proportional to the frequency of the oscillating signal or corresponding to a binary correction signal, the state of which switches for each parasitic pulse.

According to an embodiment of the present invention, the correction circuit comprises a switch adapted to alternately connecting, according to a switch control signal, an output terminal connected to the comparator at a first input terminal receiving the phase signal or at a second input terminal receiving the correction signal, the switch signal being provided from a binary signal at a first state at the level of a synchronization pulse and at a second state otherwise.

According to an embodiment of the present invention, the switch signal is also provided from at least one binary validation signal at a first state when a validation condition is fulfilled and at a second state when the validation condition is not fulfilled.

According to an embodiment of the present invention, the circuit comprises a latch providing the correction signal receiving a binary latch control signal provided from the horizontal synchronization signal, the state of the correction signal switching at each falling edge of the latch control signal.

According to an embodiment of the present invention, the circuit comprises a filter receiving the horizontal synchronization signal and providing the latch control signal, the latch control signal comprising pulses, each pulse being associated with a parasitic pulse.

The foregoing objects, features and advantages of the present invention, will be discussed in detail in the following non-limiting description of specific embodiments in connection with the accompanying drawings.

Brief Description of the Drawings

Fig. 1, previously described, shows a circuit for providing vertical and horizontal scan control signals of a TV set;

Figs. 2 and 3, previously described, show signals characteristic of the circuit of Fig. 1;

Fig. 4, previously described, shows the curve of the variation of a horizontal synchronization signal comprising parasitic pulses;

Fig. 5 schematically shows an example of embodiment of a correction circuit according to the present invention assembled on the phase-locked loop of Fig. 1;

Fig. 6 shows signals characteristic of the correction circuit of Fig. 5;

Fig. 7 shows in more detail the correction circuit of Fig. 5; and

Fig. 8 shows signals characteristic of the correction circuit of Fig. 7.

5

Detailed Description

The principle of the present invention consists of modifying signal PH so that for each parasitic pulse, comparator 22 provides a current pulse I_{PLL} , having a constant amplitude but the sign of which alternates so that control signal S_C of oscillator 26 varies generally as little as possible.

10 Figs. 5 and 6 respectively show an example of embodiment of a correction circuit according to the present invention assembled on the phase-locked loop of Fig. 1 and signals characteristic of circuit 50 in operation.

Correction circuit 50 according to the present invention is arranged between the output of frequency divider 28 and the input of phase comparator 22. Circuit 50 receives 15 at an input 51 signal PH and provides to an output 52 a signal PH'. Circuit 50 comprises a filter 53 receiving as an input horizontal synchronization signal S_{HS} and providing a rectangular latch control signal S_{LC} comprising a series of pulses, each pulse corresponding to a parasitic pulse of signal S_{HS} . Latch control signal S_{LC} is provided to a latch 54 generating a binary signal S_Q equal to -1 or 1 and the frequency of which is 20 equal to half the frequency of S_{LC} . Signal S_Q thus switches state for each parasitic pulse 40.

Circuit 50 comprises a voltage-controlled switch 55 having a terminal connected to output 52 of circuit 50 and having its other terminal connected, according to a binary switch control signal S_{IC} , to input 51 or to the output of latch 54. More specifically, 25 signal PH' is equal to signal PH when S_{IC} is at 0 and to signal S_Q when S_{IC} is at 1. Switch control signal S_{IC} is provided by a logic AND gate 56 receiving a binary validation signal of correction circuit S_M and a binary line gating signal S_{LG} inverted by an inverter 58. Line gating signal S_{LG} is equal to 1 at the level of each horizontal synchronization pulse 39 of signal S_{HS} . Signal S_M , provided by signal provision unit 14, 30 is equal to 1 over the entire duration for which signal S_{HS} comprises parasitic pulses 40. Switch control signal S_{IC} is thus at 1 when parasitic pulses 40 may be present and in the absence of a synchronization pulse 79. Logic gate 56 may receive additional validation

pulses as will be described hereafter.

Signal S_M being at 1, as long as signal S_{LG} is at 1, phase-locked loop 20 remains controlled by the "real" horizontal synchronization pulses 39. When signal S_{LG} is at 0, signal PH' is equal to S_Q and switches state for each parasitic pulse 40. This results in issuing, between two synchronization pulses, a current I_{PLL} , the average of which remains practically zero, thus avoiding a drift in control voltage S_C of oscillator 26. The method according to the present invention depends neither on the number, nor on the width, nor on the position of parasitic pulses 40.

10 Figs. 7 and 8 respectively show a more detailed diagram of an example of embodiment of correction circuit 50 of Fig. 5 and signals characteristic of circuit 50 in operation.

Filter 53 of circuit 50 comprises two series-assembled current sources 60, 61 between a high voltage V_R and the ground. Current source 60 is controlled by horizontal synchronization signal S_{HS} . Current source 61 is controlled by the inverse of signal S_{HS} , 15 designated as \bar{S}_{HS} . The terminal common to sources 60, 61 is connected to a terminal of a capacitor 62, the other terminal of which is grounded. Voltage S_{CC} across capacitor 62 is applied to the non-inverting input (+) of a voltage comparator 63. A switch 64 controlled by line gating signal S_{LG} is assembled in parallel with capacitor 62. The inverting input (-) of comparator 63 receives a reference voltage V_{REF} .

20 Comparator 63 provides signal S_{LC} transmitted to an input \bar{T} of latch 54 assembled as a divider by two. The latch also comprises a Q output which provides signal S_Q to switch 55, a reset input R receiving signal S_{LG} and an output \bar{Q} which provides the inverse of signal S_Q to a D input. At each falling edge of signal S_{LC} , signal S_Q switches to the value at input D and input D then switches to the inverse of signal S_Q .

25 Switch 55 comprises a logic gate 64 receiving signal S_Q and signal S_{IC} provided by logic gate 56. Signal S_{IC} is also provided to the input of an inverter 70 having its output connected to an input of a logic AND gate 72. The other input of logic gate 72 receives signal PH . The outputs of logic gates 64 and 72 are connected to the input of a logic OR gate 74 which provides signal PH' .

30 In the present example of embodiment, logic gate 56 comprises at least four inputs. The first input receives signal S_{LG} inverted by inverter 58. The second input

receives signal S_M . The third input receives a phase-locked loop validation signal S_{PLLV} which is at 1 when phase-locked loop 20 is synchronized in phase. The fourth input receives a standard validation signal S_{STAND} which is at 1 when the composite video signal CVBS received by the TV set corresponds to a recognized television standard. In 5 particular, signal S_M is modulated in width according to the transmission standard, that is, according to signal S_{STAND} . Logic gate 56 may receive other signals S_{OTHER} consisting for example of validation signals of specific components of the TV set.

On normal operation of the TV set, and in the area of the composite video signal where parasitic pulses are present, signals S_{STAND} , S_{PLLV} , and S_M are at 1. Signal S_{IC} is 10 then equal to the inverse of S_{LG} . When signal S_{LG} is at 1, that is, at the level of a horizontal synchronization pulse 39, signal S_{IC} is at 0 and signal PH' is equal to signal PH . When signal S_{LG} is at 0, that is, on the portions of signal S_{HS} where parasitic pulses 40 may be present, signal S_{IC} is at 1 and signal PH' is equal to S_Q .

Fig. 8 shows the variation of signals characteristic of the circuit of Fig. 7, to 15 illustrate the elaboration of signal S_Q , assuming that signals S_{PLLV} , S_{STAND} , and S_M are at 1. When line gating signal S_{LG} is at 1, switch 64 is on. Capacitor 62 is then short-circuited and if it comprises a residual charge, completely discharges. Latch 54 is reset, for example, to -1. When signal S_{LG} switches to 0, switch 64 is off. Signal S_{HS} being then generally at 0, current source 61 is active. However, the charge of capacitor 20 62 being zero, voltage S_{CC} remains zero. At the rising edge of the first parasitic pulse 40, signal S_{HS} switches to 1 and only current source 60 is activated. Capacitor 62 is then charged at constant current, voltage S_{CC} following an ascending ramp 82. At the end of parasitic pulse 40, signal S_{HS} switches to 0. Current source 61 is then activated. Capacitor 62 discharges at constant current and voltage S_{CC} follows a descending ramp 25 84 to reach the zero voltage. The charge and discharge phases of capacitor 62 are repeated for each parasitic pulse 40.

30 Comparator 63 compares voltage S_{CC} with reference voltage V_{REF} . The obtained voltage S_{LC} thus is a rectangular voltage equal to $-V_{SAT}$, where V_{SAT} is the saturation voltage of comparator 63, and which exhibits pulses at $+V_{SAT}$ for each charge and discharge cycle of capacitor 62.

At the first falling edge of voltage S_{LC} , voltage S_Q switches from 0 to 1. At each successive falling edge of signal S_{LC} , signal S_Q switches to the opposite state. Current

I_{PLL} thus exhibits pulses alternately at +I and -I. Voltage S_C across capacitor 24 of phase-locked loop 20 increases and decreases according to the direction of current I_{PLL} which runs through it and varies little on the whole. The frequency of signal S_O provided by voltage-controlled oscillator 26 is thus little disturbed by parasitic pulses 40. In 5 particular, in the case where the number of parasitic pulses 40 is even, the frequency of signal S_O does not vary on the whole.

The present invention enables keeping a fast time constant for the phase-locked loop. In this case, when the parasitic pulses stop being present between two horizontal synchronization pulses, and before provision of the video signal, the phase-locked loop, 10 in the case where signal S_O would be slightly disturbed, can catch up on the phase and frequency of horizontal synchronization signal S_{HS} before the beginning of the display of an image on screen.

Further, the correction circuit according to the present invention comprises few components and is easily integrable.

15 Of course, the present invention is likely to have various alterations, modifications, and improvement which will readily occur to those skilled in the art. In particular, voltage-controlled switch 55 may be formed in any known manner.

Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the spirit and the scope of the present invention. 20 Accordingly, the foregoing description is by way of example only and is not intended to be limiting. The present invention is limited only as defined in the following claims and the equivalents thereto.

What is claimed is: